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ABSTRACT

This experiment investigated the significance of spontaneous occurrence of number symbols in the drawings of 86 (23 male pairs and 20 female pairs) kindergarten children. A comparison was made of first grade achievement on the Piaget Number Concept Test of students who used alphabetic and numeric symbols in the Draw-a-Classroom Test in kindergarten with those who did not. The results showed no significant difference in the matched groups. The conclusion is that the spontaneous production of number symbols by children in drawings of the classrooms does not necessarily indicate later superiority in number concept ability. Appendixes provide the Piaget Number Concept Test and Study of Achievement, Phase 2, Rating Questionnaire--Mental Section (Questions 15 to 29). (DJ)

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CHILDREN'S CONCEPT OF NUMBER: THE SPONTANEOUS PRODUCTION OF NUMBER

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CHILDREN'S CONCEPT OF NUMBER: THE SPONTANEOUS PRODUCTION OF NUMBER SYMBOLS IN THEIR DRAWINGS

INTRODUCTION

In September, 1960, the Research Department of the Toronto Board of Education began a longitudinal Study of Achievement. The purpose was to study extensively the factors related to school achievement, to the learning process itself, and in particular, to the growth of mental processes in children as these are related to various areas of the school curriculum. Within the framework of its purpose a major focus of the study was the identification of some of the effects of junior kindergarten (Palmer, 1966).

As one of the techniques for this study, the Draw-a-Classroom (D.A.C.) Test was devised in an attempt to gain greater insight into the perceptions and conceptions of the child as these are related to his school world. It was expected that an "open-ended" request which asked the child to draw his classroom, would probe the child's school world without confining or distorting it through direct questioning. Moreover, the test could be administered to children of very low language competence (for example, to children in junior kindergarten). If insights into the child's world could be acquired in this manner it would be valuable in attempting to understand more fully the achievement motivation of the child within the school setting.

As the drawings of kindergarten children were being coded it was observed that, in a number of them, alphabetic and numeric symbols had been depicted in an apparently meaningful manner. For instance, in some of the drawings 1, 2, 3, 4, ... was shown while others showed a clock, complete with the numbers correctly placed. It was thought that this

spontaneous occurrence of apparently meaningful use of number symbols before its formal introduction as part of the curriculum might be predictive of the understanding of the concept of number by the child.

An examination of the literature produced no studies which had attempted to answer the question directly. While reading readiness has maintained a high level of educational research interest for many years with the resultant production and standardization of a number of tests, little attention has been focused upon the child who indicates even a minimal understanding of the concept of number.

Piaget (1952), however, in his concern with establishing the nature and origins of knowledge has applied his general theory of epistemic development to childrens' understanding of the concept of number. From the results of his research he has established three stages of number concept development which precede the use of number abstracted from real and immediate situations.

At first the child's judgements of quantity and number in a situation are bound by the particular perceptual point of view which the child adopts and is likely to change with a transformation of the referents (objects). For example, if presented with a short, squat bottle, half full of liquid which is then poured into a tall, thin bottle, the child will maintain that there is now more liquid. The child's perceptual point of view seems to be height and upon this attribute he makes judgements of quantity. When the perceptual transformation takes place, his judgements of quantity change also. This stage is referred to as the stage of "global comparisons". It is followed by an "intuitive" stage in which the child begins to understand, though not clearly or consistently,

that judgements of quantity and number cannot be made on the basis of perceived attributes alone (i.e. that attributes such as quantity and number are invariant under perceptual transformation). The third stage, that of "concrete operations", involves stability, self-consistency, and reversibility of judgements but can still be performed only on perceptually present objects. In this stage the child can now deal with classification and seriation (the two operations which, according to Piaget, are the basis of the understanding of number).

In general, Piaget's procedures have differed from those expected by experimental psychologists in North America. Dodwell (1960, 1961) has standardized the testing situation, employed a large sample and attempted to test the generality and utility of Piaget's findings. His results have, by and large, tended to substantiate those of Piaget, and Dodwell's test can be used as a tool to study children's understanding of number concepts.

The Dodwell materials seemed well suited for this investigation since the question was one of the predictive power of the spontaneous production of number symbols in drawings.

Presented formally, the question becomes, "When tested in Grade one; do children who spontaneously produced number symbols in their kindergarten drawings have a better understanding of number concepts than children who did not include numbers in their kindergarten drawings"?

METHOD

Subjects

One hundred senior kindergarten students were selected from a possible 391 students attending eight Toronto schools in 1962. (These were students for whom reading readiness test scores were available).

Selection Procedure: The Draw-a-Classroom Test was administered on two occasions to all students attending senior kindergarten in 1962. A sample of 50 students was selected from this population on the basis of the occurrence of number symbols on either of the two administrations of the drawing test. An attempt was made to match with each student in the sample, 50 other pupils who did not include number symbols in their drawings. The criteria employed in the matching were as follows:

1) Age - the maximum age range of members of a pair was three months;

2) Sex - members of a pair were of the same sex; however, both sexes were included in the sample;

3) School Experience - members of a pair had to have a) attended the same school from the inception of the study and b) had the same school promotion experience;

4) Reading Readiness Score - members of a pair had to score within ± 1 point of each other on the Dominion Reading Readiness Test (Short Form);

5) Rating Questionnaire Score - of a possible 1 to 120 score on the Mental section of the Rating Questionnaire (cf. Appendix B) members of a pair had to have scores within a range of ± 10 points of each other;

6) Socio-economic Status - wherever possible, pairs were matched using a seven-point scale based on father's occupation (Holingshead & Redlich, 1958).

After matching was completed it was found that there was a small attrition rate from the original sample. Despite attempts at rematching, the final sample included only 43 usable pairs, 23 male pairs and 20 female pairs. All pairs came from only five of the eight schools originally selected. For convenience the group comprising students who included number symbols in their drawings have been designated Group NS, while Group NNS refers to those subjects which included no number symbols in their drawings.

Procedure

The Piagetian testing situation standardized by Dodwell (1960), here referred to as the "Piaget Number Concept Test", was used to assess each subject's understanding of the concept of number (cf. Appendix A). The Metropolitan Achievement Test was also given, as a verification test for the findings of the Piaget Number Concept Test. Four testers were used to administer the tests one year after the D.A.C. test was administered.

A number of precautionary steps had to be taken in order to insure that differences in scores between the two groups of subjects were not due to differences among schools and testers, since there were two subjects to each of the 43 matched pairs coming from five schools, and only four testers. Thus, the same tester administered the test to both members of a pair, and the selection of which tester administered the tests to which pairs was done on a random basis, with the single restriction that each tester had to test pairs from at least two schools. Testers did not know which member of a pair had included numbers in their drawings.

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Total scores for both the Metropolitan Achievement Test and the Piaget Number Concept Test were recorded. Also recorded were the scores for the Arithmetic section of the Metropolitan Achievement Test and the "A" score of the Piaget Number Concept Test. The "A" score indicates the degree of functioning of the child within the stage of "global comparisons" (see text, p.2).

RESULTS

The results for three of the factors used in the matching procedure are shown in Fig. 1, 2, and 3. These curves show the number of subjects in each of the groups at each level of a factor. It is apparent from these curves that the matching procedure produced two groups that were nearly equal at all levels of these factors. The saw-tooth pattern evident in Fig. 3 showing the distribution of age levels in the two groups was primarily due to the allowance of a three month range in the date of birth of a matched pair, the average age of the two groups was almost identical.

From the scores on each of the tests used, averages were calculated for each group. These average scores are shown in Table 1. The differences between the scores for the matched pairs were analysed by means of a "t-test". The results of this analysis are shown also in Table 1. An examination of these results indicates quite clearly that there are no differences between the groups in their scores on any of these tests.

Since each group was comprised of 23 males and 20 females it was thought that the differences between the groups may have been masked by the use of average scores based on both males and females. The sex of the subjects was therefore used as a sub-classification and the differences between the matched pairs analysed separately for males and females. The results of this analysis are shown in Table 2. It is quite clear from this analysis that, in fact, the groups did not differ even when compared separately according to sex of the matched pairs.

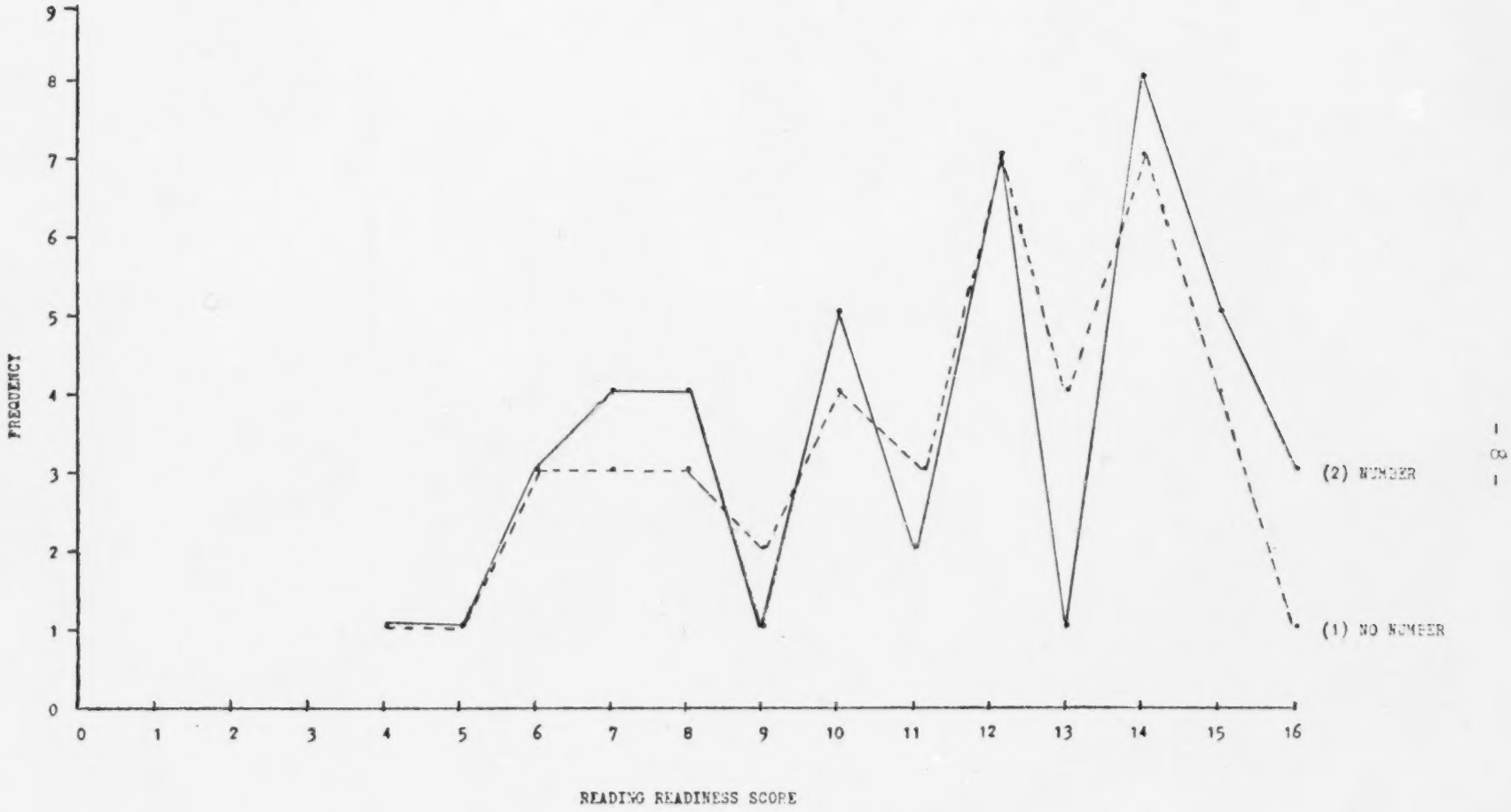

Figure 1. Frequency distribution of scores of the two groups on the Dominion Reading Readiness Test.

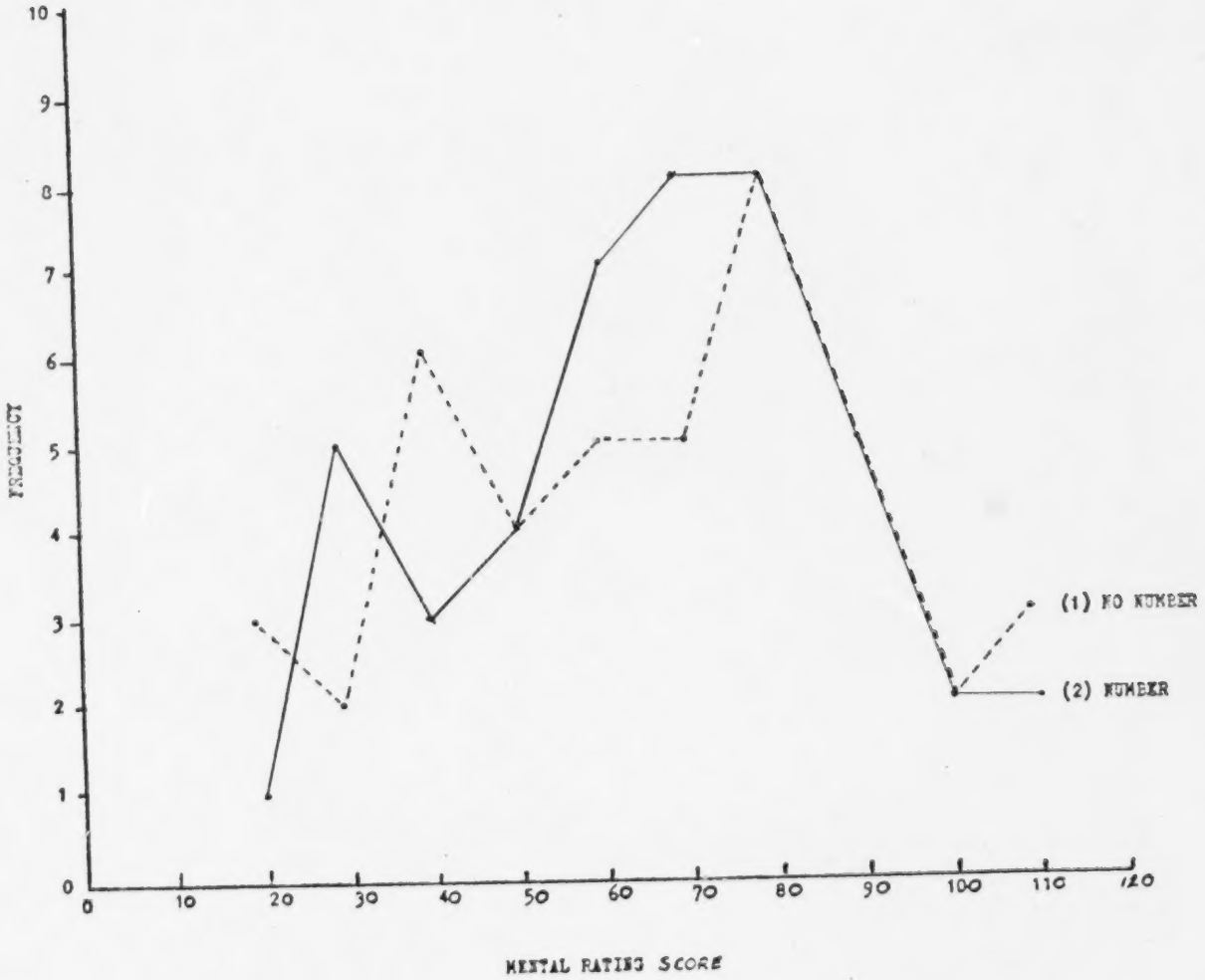

Figure 2. Frequency distribution of scores of the two groups for the Mental section of the Rating Questionaire of the Study of Achievement.

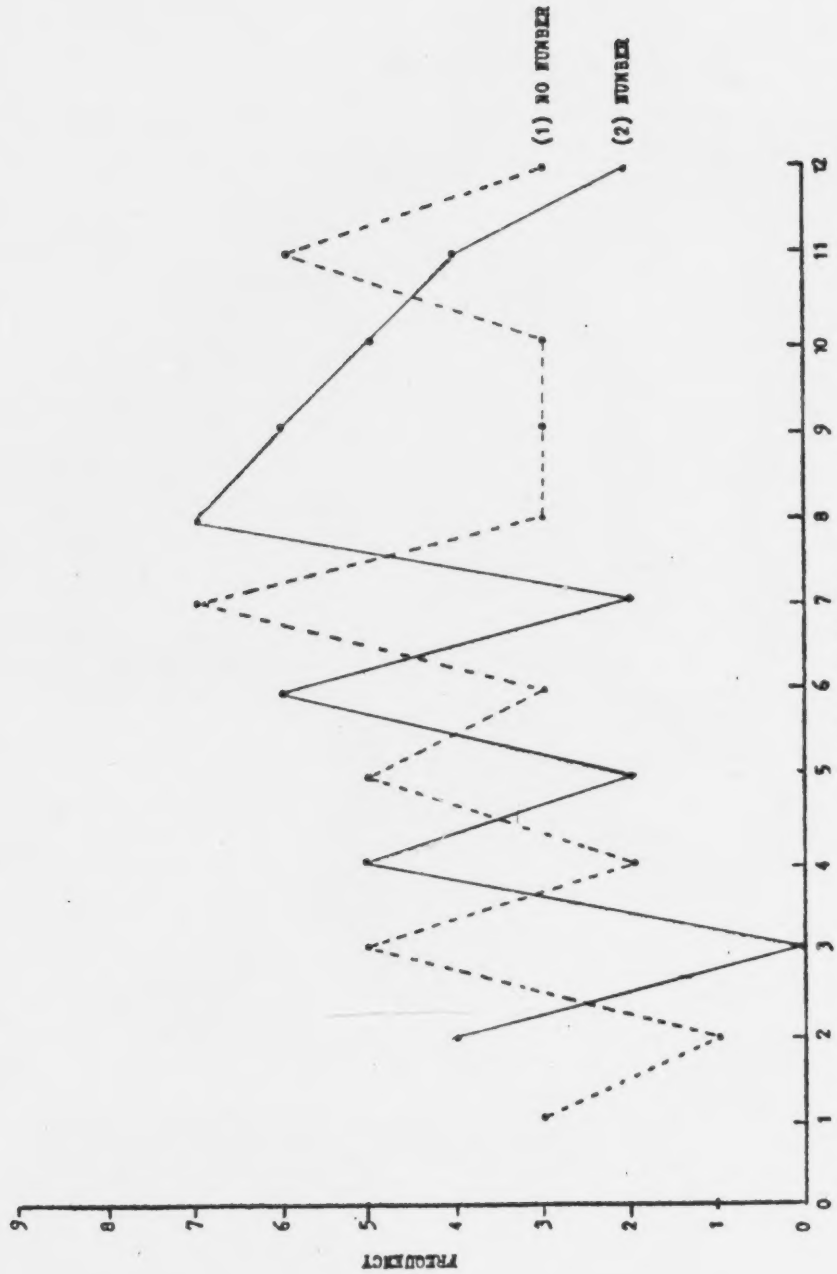

Figure 3. Frequency distribution of age according to month of birth in 1956 for the two groups.

An examination of the average scores in Table 2 shows that for some of the tests there seemed to be a difference between males and females within a group. Further analyses of these scores are shown in Table 3. Again it was found through a "t-test" analysis that these apparent differences were not statistically significant.

Table 4 shows the correlations involving the scores of all subjects on the measures employed in the study including those employed in the matching procedure. The purpose of this analysis was to establish the degree of relationship among the test instruments used. That is, do subjects who score high on one test tend to score high on any of the other ones and to what degree does this relationship hold. A value of 0.00 indicates no relationship while a value of |1.00| indicates a perfect positive or negative relationship depending on the sign.

As can be seen from Table 4 scores on The Dominion Reading Readiness Test, the Metropolitan Achievement Test (both Total and the Arithmetic Section scores) and the Mental Section of the Achievement Questionnaire show a moderate relationship. The value of the relationship between the Total score on the Metropolitan Achievement Test and the Arithmetic Section of that test is inflated because the latter is a subsection of the former.

Of all the measures only the Arithmetic Section of the Metropolitan Achievement Test correlates well with the Piaget Number Concept Test. This result is not surprising since they both attempt in different ways, to measure number concept ability; the relationship does serve to substantiate the results on the Piaget Number Concept Test.

The negative correlation between the "A"-score of the Piaget Number Concept Test and all other measures is to be expected since the smaller the "A"-score the better the individual's mastery of number concepts.

Also evident in Table 4 is the consistent low correlation between age and all other measures used. The highest correlation exists between age and the Dominion Reading Readiness score. These results are not surprising in view of the fact that age was used as a matching factor and the total range in age was one year.

TABLE 1

AVERAGES AND "t-TEST" RESULTS OF A COMPARISON OF DIFFERENCES BETWEEN THE GROUP HAVING NUMBER SYMBOLS IN DRAWINGS (NS) AND THE GROUP NOT HAVING NUMBER SYMBOLS IN DRAWINGS (NNS) FOR EACH OF FOUR MEASURES[1]

Type of Test Score Used	Average Score Group NS (N = 43)	Average Score Group NNS (N = 43)	t-test Value	Significance Level[2]
Total Score: Metropolitan Achievement Test	200.3953	200.9534	0.1298	ns[3]
Arithmetic Section Score: Metropolitan Achievement Test	49.5116	50.6976	0.9653	ns
Total Score: Piaget Number Concept Test	46.1860	46.3488	0.1691	ns
"A" Score: Piaget Number Concept Test	1.9069	1.7441	0.4327	ns

1) Analysis performed as t-test of differences between average scores for correlated samples (Ferguson, 1959 p.138).

2) The level at which a difference in average scores would be accepted as reflecting a difference in number concept understanding ($p < .01$).

3) ns - not statistically significant

TABLE 2

AVERAGES AND "t-TEST" RESULTS FOR A COMPARISON OF DIFFERENCES BETWEEN GROUPS, SEPARATELY FOR MALES AND FEMALES[1]

Type of Test Score Used	Sub-grouping	Average Score Group NS (N = 43)	Average Score Group NNS (N = 43)	t-test value	Significance Level
Total Score: Metropolitan Achievement Test	Male	197.7826	197.2173	.1012	ns
	Female	203.4000	205.2500	.2724	ns
Arithmetic Section Score: Metropolitan Achievement Test	Male	50.1304	50.9565	.5021	ns
	Female	48.8000	50.4500	.8762	ns
Total Score: Piaget Number Concept Test	Male	47.2173	46.6086	.6487	ns
	Female	45.0000	46.0500	.5911	ns
"A" Score: Piaget Number Concept Test	Male	1.7391	1.5217	.4943	ns
	Female	2.1000	2.0000	.1656	ns

1) Analysis of difference between average scores for correlated samples (Ferguson, 1959, p.168).

TABLE 3

AVERAGES AND "t-TEST" RESULTS FOR A COMPARISON OF DIFFERENCES BETWEEN MALE AND FEMALE WITHIN EACH GROUP FOR EACH OF FOUR MEASURES [1]

Type of Test Score Used	Group	Average Score Male (N = 23)	Average Score Female (N = 20)	t-test Value	Significance Level
Total Score: Metropolitan Achievement Test	NS	197.7826	203.4000	0.5818	ns
	NNS	197.2173	205.2500	0.8535	ns
Arithmetic Section Score: Metropolitan Achievement Test	NS	50.1304	48.8000	0.5762	ns
	NNS	50.9565	50.4500	0.2237	ns
Total Score: Piaget Number Concept Test	NS	47.2173	45.0000	1.0990	ns
	NNS	46.6086	46.0500	0.3204	ns
"A" Score: Piaget Number Concept Test	NS	1.7391	2.1000	.6433	ns
	NNS	1.5217	2.0000	1.0702	ns

1) Analysis of difference between average scores for independent samples. (Ferguson, 1959, p. 136).

TABLE 4

SUMMARY TABLE OF A CORRELATION ANALYSIS OF
MEASURES USED IN THIS STUDY (N = 86)

Type of Measure Employed	Mental Rating Achievement Questionnaire	Total Score: Metropolitan Achievement Test	Arithmetic Section Score: Metropolitan Achievement Test	Total Score: Piaget Number Concept Test	"A" Score: Piaget Number Concept Test	Age
Dominion Reading Readiness Test	0.63	0.64	0.52	0.11	-0.09	0.32
Mental Rating Achievement Questionnaire		0.53	0.47	0.45	-0.12	0.22
Total Score: Metropolitan Achievement Test			0.71	0.47	-0.18	0.20
Arithmetic Section Score: Metropolitan Achievement Test				0.54	-0.26	0.18
Total Score: Piaget Number Concept Test					-0.65	0.11
"A" Score: Piaget Number Concept Test						-0.11

DISCUSSION

The results of this experiment clearly indicate that the spontaneous production of number symbols by children in drawings of their classrooms does not necessarily indicate later superiority in number concept ability. On the contrary, it is clear from the results that such inclusions of number symbols bear no predictive utility with respect to the development of mathematical understanding as reflected by the Arithmetic Section of the Metropolitan Achievement Test or the Piaget Number Concept Test.

This is not to say that the experimental findings or, for that matter the study itself, was useless. In fact, it raises, as well as some subsidiary evidence, interesting questions and implications. There is no implication in these results that at the time the drawings were completed the child who included number symbols did not have greater number concept understanding than one who did not. The year between drawing completion and testing may have proved the equalizer.

It was found that there was no difference between males and females in their scores on either of the mathematics tests employed, suggesting that males and females do not differ in their understanding of the concept of number. This finding, although consistent with those of Dodwell (1961) and Piaget (1952) is contrary to the popular conception and much experimental evidence (e.g. Hughes, 1953; Shaw and McCuen, 1960) that females tend to show higher achievement performance than their male age-mates. The most common measure of achievement in studies finding this superiority has been academic performance. Lavin (1960, p.130), in attempting to explain this difference,

has suggested that:

> "the significance of these findings can be understood in terms of the variety of differences in attitudes and behaviour which result from the fact that males and females are socialized differently. Each sex must learn to play a different role, and the attitudes and values associated with sex-role learning may help explain sex differences in academic performance."

Put another way, the test instrument measures responses which have been more strongly reinforced in girls than in boys. The lack of difference between scores for males and females in this study would suggest that the test instrument of this study were not subject to this socialization bias.

It cannot be argued that the instruments were simply not sensitive to the difference between sexes in number concept ability because the test instruments used to measure this ability did so from two very different points of view and it was found that both the Arithmetic Section of the Metropolitan Achievement Test and the Piaget Number Concept Test were fairly highly correlated.

Also, there was a low correlation between age and the test instruments employed. This result supports the findings of Dodwell (1960, 1961) and would support the conclusion that the stages of number concept development are not as clearly or as rigidly age-dependent as Piaget (1952) would suggest.

In light of the above findings and the proposed changes in the school curriculum (abolition of marks, etc.) it would seem advantageous to use the Piaget Number Concept Test as an indicator of a child's readiness to attempt mathematical reasoning. If a child of five or six years of age scores high on the Piaget Number Concept Test then the teacher could initiate instruction, with familiar toys, materials, etc. which would develop the child's number

concept ability. Such a test would eliminate the reliance on age or grade to indicate a child's readiness to proceed with the mathematical aspect of the curriculum and make the initiation of such learning dependent upon the individual not the class. However, it would be necessary to follow up this implication with research which substantiates its utility. Some evidence (Estes, 1956) suggests that this point of readiness may be reached when the child has learned to count. Estes found that children who could not count were unable to perform at a scorable level on experimental tasks similar to those employed by Piaget (1952).

That this experiment found no predictive utility in the inclusion of number symbols in children's drawings of their classrooms with respect to number concept development does not answer the more general question of the significance of inclusions of number symbols in drawings. What significance, if any, is reflected in the fact that some children include number symbols in their drawings while others do not? At a surface level the answer would most likely be "Nothing! Some children include birds in their drawings and others do not - so what?" But this highly technological society puts high value on its primary tools, of which mathematics is one. The question remains: does the inclusion of number symbols in the drawings of children have implications for either mathematics achievement or to the understanding of cultural influences on the perceptions of children?

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APPENDIX A

PIAGET NUMBER CONCEPT TEST

Name: _____ Age: _____ I.Q.: _____ School: _____

Father's Occupation: _____ Tester: _____

"I want you to help me to find out some things about numbers. Would you like to do that? We'll play some games afterwards, and see what we can find out about numbers, etc...."

1. "First of all, can you tell me how many fingers there are here?" (show hand) R ☐ W ☐ C ☐

---

2. "Now, can you tell me how many hands you have?" Yes ☐ No ☐

---

3. "How many blocks are there here?" (show 4) R ☐ W ☐ C ☐

"How many are there now?" (after adding one more) If no response, ask again. R ☐ W ☐ C ☐

---

4. Beads and beakers. Let child count 6 into each beaker, in pairs. "Are there the same number of beads in each glass?" Y ☐ N ☐ DN ☐ Other ☐

"How do you know?"

They look the same ☐
Same height ☐
Other ☐
Don't know ☐

.....

Counted ☐

---

5. Pour from one into narrow beaker. "Are there the same number of beads in each glass now?" Y ☐ N ☐ DN ☐

"Which has more? Why?"

Looks higher here ☐
Looks more here ☐
Don't know ☐
Other ☐

6. Repeat, counting 8 into dissimilar beakers. "Are there the same number in each glass? Which has more? Why?"

Y ☐ N ☐ DN ☐

- Looks higher here ☐
- Looks more here ☐
- I counted them ☐
- Other ☐
- Don't know ☐

7. Pour from narrow to normal beaker. "Are there the same number in each glass now? Which has more? Why?"

Y ☐ N ☐ DN ☐

- Looks same ☐
- Don't know ☐
- Other ☐

8. Eggs and cups. Arrange 6 cups in row (2" apart). Ask child to put one egg in each cup. "Are there the same number of eggs and cups?"

Y ☐ N ☐ DN ☐

(If N, question further: which has more? Why?)
Answer _____

9. Remove eggs, place in row close to cups. "Have we still got the same number of eggs and cups?" "How do you know?"

Y ☐ N ☐ DN ☐

- There's one for each ☐
- We counted them out ☐
- Other ☐

10. Bunch up the eggs and ask again, "Are there the same number of eggs and cups now?"

Y ☐ N ☐ DN ☐

"Are there more eggs, or more cups? Why are there more eggs?"

- There are more here ☐
- Looks more here ☐
- Don't know ☐
- Other ☐

11. Ask child to put eggs back <u>in</u> cups. "Are there the same number of eggs and cups now? (Yes) So were there as many eggs as cups when the eggs were all bunched up <u>here</u>?"

Y ☐ N ☐ DN ☐

If answer "No", ask "why not?"

- There were more here ☐
- The eggs were all together ☐
- Don't know ☐
- Other ☐

12. Arrange 6 chips in row (about 1" apart). "Can you put out another row like this one?" R ☐ W ☐

"How many coloured pieces are in this row?" R ☐ W ☐

"How many are there in your row?" R ☐ W ☐

"So are there as many in your row as there are in my row?" R ☐ W ☐

13. Spread out first row (about 2" apart). "Which row has more pieces in it now?"

- First row more ☐
- Both same ☐
- Other ☐

"Why?"

- This row is longer ☐
- Looks more ☐
- Don't know ☐
- Other ☐

14. "Can you make as many in your row as there are here?"

- Puts out more ☐
- Moves own pieces ☐
- Other. ☐

15. Put 1st row back in original position. "Are there the same number in each row now?" R ☐ W ☐

"Why are there more in this row?"

- Looks more ☐
- Row is longer ☐
- Counted them ☐
- Don't know ☐
- Other ☐

16. Can you make the two rows the same again, with the same number of pieces in each?

- Moves pieces ☐
- Removes pieces ☐
- Other ☐

17. "Are there the same number in each row now?" R ☐ W ☐

18. "Here are some little men; some of them are small, some bigger. I am going to put them in order, from the smallest to the largest. Do you see? Here is the smallest...., etc. Each man has a stick to walk with; a small one for the smallest man, a larger one for the next, etc. (Put down two sticks.) I want you to put down the stick which belongs to each man in front of him." Help if unable to proceed. Record number correctly placed by child.

- 1 right ☐
- 2 right ☐
- 3 right ☐
- 4 right ☐
- 5 right ☐
- 6 right ☐

Spread out men. "Now tell me which stick belongs to this man?" (smallest) R ☐ W ☐

"And to this one?" (second from largest) R ☐ W ☐

"And to this one?" (4th from largest) R ☐ W ☐

Jumble up men and sticks. "Which stick belongs to this man?" (largest) R ☐ W ☐

"And to this one?" (3rd from smallest) R ☐ W ☐

19. "How do you find out?"

- Count from largest smallest ☐
- Look for stick same size ☐
- Don't know ☐
- Other ☐

20. Blocks and stairs
"I am going to show you how to build a staircase with these blocks. The first stair has one block, the second has two. Can you build the next stair?" R ☐ W ☐
"How many blocks are there in it?" R ☐ W ☐
"Which stair is it? This is the first, this is the second, and this is the .....?" R ☐ W ☐

21. "Can you build the next two steps?" (Help, if necessary.) R ☐ W ☐
"What would be the next step?" R ☐ W ☐
"How many blocks would there be in it?" R ☐ W ☐

22. "How many steps will the man have climbed to get here?" (3rd stair) R ☐ W ☐
"How many has he still to go?" R ☐ W ☐

23. Remove 3rd step. "How many blocks would there be in the step I took away?" R ☐ W ☐
"Can you build it for me?" (not in position) R ☐ W ☐

24. "If I built ten steps, how many blocks would there be in the highest step?" R ☐ W ☐
"What would the next step be called?" R ☐ W ☐
"How many blocks would there be in it?" R ☐ W ☐

OBSERVATIONS AND SPECIAL REMARKS

APPENDIX B

Study of Achievement, Phase 2

Rating Questionnaire

Mental Section (Questions 15 to 29)

Here is an example of how a child might be rated for Question 21.

(a) If the child is always asking for help with his decisions and in his use of the kindergarten equipment and materials, rate 0.

(b) If the child can solve his own problems with some decisions and with some of the equipment, rate 4.

(c) If the child can solve his own problems suitably for any situation for the greater part of the day, rate 6 or 8.

Now rate the child on the following observations.

Put your rating in the coding space at the right.

15. Names and identifies the following colours: red, yellow blue, green.

e.g. If the child can name and identify all standard colours, rate 6.
If the child can name and identify shades and blends, rate 8. _____

16. Decides on own initiative what to do in the Activity Period.

If the child needs a lot of help from the teacher to decide what to do or is very hesitant to decide or shows fear of trying new materials, rate 0.
If the child readily tells the teacher what he is "going to do", rate 4.
If the child readily states what he is "going to do"; chooses a wide variety of activities from day to day; can also decide "how" or "what" he is going to make or do with his choice of activity, rate 6 or 8. _____

17. Remains interested in a self-chosen activity for 30 minutes.

N.B. This might be block building, painting, pasting, dramatic play.
If the child can concentrate frequently on one activity for 30 minutes or more, rate 6 or 8. _____

18. Remains interested in teacher guided group activities for 15 minutes.

If the child often disturbs others and is readily distractible, rate 0.
If the child concentrates and remains interested frequently for the whole length of time involved in the activity, rate 8. _____

19. Carries over a colouring, painting or pasting project for one day.

If the child <u>on his own initiative</u> has spent one complete Activity Period working on <u>one</u> piece of work <u>and</u> wishes <u>on his own initiative</u> to work on it the next day, <u>rate 4</u>.
If the child is capable of doing this often, or carries projects over for several days, <u>rate 6 or 8</u>. _____

20. Follows one line of thought in a discussion period.

If the child cannot concentrate on "the subject" of discussion, talks about something else and is restless, <u>rate 0</u>.
If the child can follow and talk about "the subject matter", <u>rate 4</u>.
If the child can talk frequently about "the subject" under discussion, use good vocabulary and contribute good thinking, <u>rate 6 or 8</u>. _____

21. Solves own problems with toys, puzzles, handwork, rules, etc.
_____

22. Differs <u>in a well-balanced manner</u> from opinions of others in discussion times or at play.

If the child never volunteers opinions or is afraid to state own opinions, <u>rate 0</u>.
If the child shows an unpleasant manner when he differs from others, <u>rate 2</u>.
If the child frequently shows evidence of good thinking and ability to differ in a well-balanced manner, <u>rate 6 or 8</u>. _____

23. Follows directions in games or routine situations.

If the child needs the teacher's directions repeated frequently or needs frequent help from the teacher in carrying out directions, <u>rate 0</u>.
If the child can manage by himself, <u>rate 4</u>.
If the child can manage by himself consistently, <u>rate up to 8</u>. _____

24. Thinks in a logical way. -- The child has the ability to make deductions or inferences from pictures, about things, about rules, etc.

    If the child is afraid or unable to reason, rate 0.
    If the child is often poor at reasoning, rate 2. _____

25. Counts up to five objects, or people or things in a picture. _____

26. Uses words related to number, size or quantity -- big, little, first, long, many, etc.

    If the child uses such words with good understanding, rate 8. _____

27. Uses words related to quality -- thick, thin, sharp, flat, etc.

    If the child uses such words with good understanding, rate 8. _____

28. Uses words related to time -- day, month, hour, week, etc.

    If the child uses such words with good understanding, rate 8. _____

29. Uses words related to space -- near, far, on top, around, etc.

    If the child uses such words with good understanding, rate 8. _____